

WHAT IS CLAIMED IS:

1. Apparatus for measuring the instantaneous distance between the stern of a vessel (A) and a fixed structure (B, C) such as a quay, jetty, landing stage or the like, during a reversing operation for docking alongside the said fixed structure, including:

- a plurality of transmitter-receiver means (10, 20) for emitting acoustic signals in the form of beams (F1, F2) rearwardly from the stern and for receiving acoustic signals reflected by the fixed structure (B, C), wherein the number of transmitter-receiver means and the angle of aperture of the respective beams are such that their overall field of view includes substantially all the area behind the stern, and wherein each transmitter-receiver includes transducer means operable to convert first input electrical signals into output acoustic signals and to convert reflected acoustic signals into second electrical signals to supply to electronic processing means;

- electronic processing means coupled electrically to the transmitter-receiver means for

- supplying the said first electrical signals cyclically to the said transducer means,

- receiving the said second electrical signals converted from reflected acoustic signals, and

- determining the instantaneous distance between the vessel and the fixed structure on the basis of first and second electrical signals;

- visual and/or acoustic signalling means coupled to the electronic processing means for producing a visual and/or

acoustic signal in real time indicating the determined instantaneous distance.

2. Apparatus according to Claim 1, in which the transmitter-receiver means include at least one first long-range transmitter-receiver unit (10) for emitting a first output acoustic signal in the form of a beam (F1) with a range of around 7-15 metres.

3. Apparatus according to Claim 2, in which the said first transmitter-receiver unit (10) is operable to emit a first output acoustic signal in the form of a beam (F1) with a narrow beam angles ( $\alpha$ ), of around 8-20°.

4. Apparatus according to Claims 1, in which the transmitter-receiver means include at least one second, short-range transmitter-receiver unit (20) for emitting a second output acoustic signal in the form of a beam (F2) with a wide beam angle ( $\beta$ ), greater than 20° and preferably of around 60-120°.

5. Apparatus according to Claim 4, in which the said second transmitter-receiver unit (20) is operable to emit a second output acoustic signal in the form of a beam (F2) with a short-range of around 1-2 metres.

6. Apparatus according to Claims 1, including in combination:

at least one first long-range transmitter-receiver unit (10) for emitting a first output acoustic signal in the form of a beam (F1) with a range of around 7-15 metres; and

at least one second short-range transmitter-receiver unit (20) for emitting an output acoustic signal in the form of a beam (F2) with a beam angle ( $\beta$ ) greater than  $20^\circ$  and preferably of around  $60-120^\circ$ .

7. Apparatus according to Claim 6, including:

- a plurality of first long-range transmitter-receiver units (10), mounted aligned in at least one longitudinal vertical plane on the stern of the vessel, so as to direct rearwardly a corresponding plurality of first conical beams (F1) with substantially horizontal axes, parallel to one another in at least one longitudinal vertical plane; and
- a plurality of second short-range transmitter-receiver units (20) mounted on the stern of the vessel and aligned in a horizontal plane so as to direct a corresponding plurality of second conical beams (F2) with substantially horizontal axes, parallel to one another in at least one substantially horizontal plane.

8. Apparatus according to Claim 7, wherein the first long-range transmitter-receiver units (10) are mounted aligned in a longitudinal vertical plane passing through the centre line of the vessel.

9. Apparatus according to Claim 7, wherein the second short-range transmitter-receiver units (20) are mounted to the side of the first units (10).

10. Apparatus according to Claim 6, including:

- at least one short-range transmitter-receiver unit (20) mounted on the stern of the vessel for directing at least one

second output acoustic signal rearwardly in the form of a beam (F2) with a beam angle ( $\beta$ ) greater than  $20^\circ$  along a rearward longitudinal path, and

- a first and a second series of first long-range transmitter-receiver units (10), mounted on the stern of the vessel aligned in two longitudinal vertical planes, to either side of the second unit (20) so as to direct rearwardly two corresponding series of first conical beams (F1) with substantially horizontal axes, parallel to one another in the said longitudinal vertical planes.

11. Apparatus according to Claim 2, including:

a first series of long-range transmitter-receiver units (10) mounted on the stern of the vessel and spaced vertically, and a second series of long-range transmitter-receiver units (10) mounted on the stern of the vessel and spaced laterally.

12. Apparatus according to Claim 11, including:

a first series of long-range transmitter-receiver units (10) aligned along a central longitudinal vertical plane, and a second series of long-range transmitter-receiver units (10) aligned in a horizontal plane.

13. Apparatus according to Claim 1, wherein the transmitter-receiver units include at least one transmitter-receiver

(10, 20) operable to emit an output acoustic signal in the form of a conical beam (F1, F2).

14. Apparatus according to Claim 1, wherein the transmitter-receiver units include at least one transmitter-receiver (10, 20) operable to emit an output acoustic signal in the form of

a beam (F1, F2) with different beam angles in the vertical plane from the horizontal plane.

15. Apparatus according to Claim 14, in which the transmitter-receiver units include at least one long-range transmitter-receiver unit (10) operable to emit an acoustic signal in the form of a beam (F1) with a wider beam angle in a vertical plane and a narrower beam angle in a horizontal plane.

16. Apparatus according to Claim 1, wherein the transmitter-receiver units (10, 20) are operable to emit acoustic signals in the form of beams (F1, F2) in configuration which is symmetrical relative to a longitudinal vertical plane passing through the centreline of the vessel.